Occidental Chemical Corporation

EVALUATION OF MW-52 AREA GROUNDWATER EXTRACTION SYSTEM FOR RECOVERY OF GROUNDWATER FROM THE HOOKER/RUCO SITE

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EXECUTIVE SUMMARY

Pursuant to a request from the U.S. Environmental Protection Agency (EPA), Occidental Chemical Corporation (OxyChem) has evaluated the use of a groundwater extraction system based in the area of well nest MW-52 for the extraction and treatment of groundwater which has migrated from the Hooker/Ruco facility. The goal of the evaluation was to determine if the operation of the system for a limited period (i.e., less than 10 years) could reduce levels of chemistry in the groundwater sufficiently that when combined with natural attenuation, the system would prevent chemical concentrations in excess of regulatory levels reaching either the Northrop IRM system or the Bethpage drinking water supply wells.

Previous evaluations performed by Northrop Grumman Aerospace Corporation (Northrop) and OxyChem have shown that the Northrop Interim Remedial Measure (IRM) would capture the total volatile organic compound (TVOC) plume in the groundwater underlying the Northrop, Navy, and Ruco sites located upgradient of the Northrop IRM wells GP-1, ONCT-1D, ONCT-2D, and ONCT-3D. The evaluations showed that there was a potential for vinyl chloride monomer (VCM) in the groundwater from the area of well nest MW-52 to migrate to well GP-1 at concentrations which would require supplemental treatment to prevent exceedence of the Air Guide 1 criteria of 0.02 $\mu g/m^3$. It is believed that pumping in the MW-52 area will reduce the further southerly migration of chemistry from the area, and will remove a sufficient mass of VCM from within the area of elevated VCM presence so that supplemental VCM treatment at GP-1 would not be required. It will also provide the additional benefit of addressing the chemical presence in the shallow groundwater underlying the Ruco Site, a component of Operable Unit-1 (OU-1). This document presents an evaluation of supplemental pumping in the MW-52 area.

The basic pumping well scheme evaluated was a multiple well system consisting of a single well (VCM-1) located approximately 500 feet downgradient of MW-52 with two additional wells (i.e., VCM-2 and VCM-3) located approximately 1,000 feet downgradient of MW-52.

The evaluations showed that:

i) a multiple well system with a total pumping rate on the order of 600 gpm for a pumping period of 7 to 8 years will be needed to ensure that the mass of VCM removed will be protective on the Northrop IRM wells so that future supplemental treatment of VCM will not be needed;

ii) such a system will ensure that VCM will not reach the Bethpage water supply wells at concentrations which would exceed the MCL of 2 μg/L even if the Northrop IRM wells are not pumping; and

iii) such a system has the added benefit of addressing the shallow groundwater and soil flushing components of OU-1.

Based on the computer simulations and evaluations, the recommended system consists of:

i) VCM-1 to be installed approximately 500 feet downgradient of MW-52 pumping at 500 gpm.

ii) VCM-2 and VCM-3 to be pumped at 50 gpm each.

iii) Pumping will continue until the VCM concentration in VCM-1 reduces to 40 μg/L. It is estimated pumping for 7 to 8 years will be needed to achieve this concentration.

iv) The pumped groundwater will be treated at a treatment facility to be constructed in the southwest portion of the Hooker/Ruco facility.

v) Treated water will be:

   a) used to flush the soils in the area of Sump 1, Sump 2, and/or monitoring well E, and

   b) discharged to a recharge basin to be constructed in the northwest portion of Hooker/Ruco facility;

vi) Monitoring will be performed at 12 wells semi-annually to monitor the effectiveness of the system.

The estimated capital cost for the OU-3 component of the MW-52 area system is $3,128,000 with annual operation and maintenance costs ranging from $643,000 to $691,000. The present worth, based on a 7.5 year operating period, ranges from $7,066,000 to $7,360,000. The use of the MW-52 area system to address the shallow groundwater component of OU-1 has been estimated to reduce the OU-1 capital costs by $446,500 and reduce the annual O&M costs by $57,000.

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1.0 INTRODUCTION

Pursuant to a request from the U.S. Environmental Protection Agency (EPA), Occidental Chemical Corporation (OxyChem) has evaluated the use of a groundwater extraction system based in the area of well nest MW-52 for the extraction and treatment of groundwater which has migrated from the Hooker/Ruco facility. The goal of the evaluation was to determine if the operation of the system for a limited period (i.e., less than 10 years) could reduce levels of chemistry in the groundwater sufficiently that when combined with natural attenuation, the system would prevent chemical concentrations in excess of regulatory levels reaching either the Northrop IRM system or the Bethpage drinking water supply wells.

Previous evaluations performed by Northrop Grumman Aerospace Corporation (Northrop) and OxyChem have shown that the Northrop Interim Remedial Measure (IRM) would capture the total volatile organic compound (TVOC) plume in the groundwater underlying the Northrop, Navy, and Ruco sites located upgradient of the Northrop IRM wells GP-1, ONCT-1D, ONCT-2D, and ONCT-3D. The evaluations showed that there was a potential for vinyl chloride monomer (VCM) in the groundwater from the area of well nest MW-52 to migrate to well GP-1 at concentrations which would require supplemental treatment to prevent exceedence of the Air Guide 1 criteria of 0.02 $\mu g/m^3$.

It is believed that pumping in the MW-52 area will reduce the further southerly migration of chemistry from the area, and will remove a sufficient mass of VCM from the area of elevated VCM presence so that supplemental VCM treatment at GP-1 would not be required. It will also provide the additional benefit of addressing the chemical presence in the shallow groundwater underlying the Ruco Site, a component of Operable Unit 1 (OU-1) for the Ruco Site. This document presents an evaluation of supplemental pumping in the MW-52 area.

2.0 MW-52 AREA SYSTEM OBJECTIVES AND DESCRIPTION

2.1 MW-52 AREA SYSTEM OBJECTIVES

The objective of pumping from the MW-52 area is to remove sufficient VCM mass from the present area of elevated VCM presence by short-term pumping and treatment so that VCM from the MW-52 area will not migrate to the Northrop IRM wells at concentrations which would require separate supplemental treatment in the future. The hydrogeologic modeling efforts that have been performed show that irrespective of whether GP-2, GP-5, or an extraction well is installed in the MW-52 area, the VCM component of the TVOC plume is within the capture zone of the Northrop IRM well system. Consequently, it is expected that all of the VCM will eventually reach and be captured by the Northrop IRM wells.

The Air Guide 1 criteria for VCM is 0.02 $\mu g/m^3$. The VCM groundwater concentration needed to exceed this criteria for a flow rate of 1,100 gpm at GP-1 is calculated to be 8.3 $\mu g/L$ (see Table 2.1). It was believed prudent to implement an MW-52 area system that would result in simulated VCM concentrations on the order of 1 $\mu g/L$ at GP-1 to provide sufficient confidence that the VCM concentrations at GP-1 would not exceed the Air Guide 1 criteria of 8.3 $\mu g/L$ and that the maximum contaminant level (MCL) of 2 $\mu g/L$ be achieved.

2.2 SYSTEM DESCRIPTION, PUMPING RATE AND PUMPING PERIOD EVALUATION

The pumping well scheme simulated to determine the effect that removing a portion of the VCM mass from the MW-52 area would have on the VCM concentrations at GP-1 was a multiple well system consisting of one well (VCM-1) located approximately 500 feet downgradient of MW-52 with two additional wells (VCM-2 and VCM-3) located approximately 1,000 feet downgradient of MW-52. The simulation involved pumping VCM-1 at 500 gpm and VCM-2 and VCM-3 at 50 gpm each for 7.5 years. The proposed pumping well locations are shown on Figure 2.1 and a schematic cross-section is shown on Figure 2.2. Figure 2.2 shows that the elevated VCM presence is located in depth intervals ranging from approximately 100 to 360 feet bgs.

The well locations were selected to ensure that the lateral extent of the cross-gradient VCM presence in the MW-52 area (i.e., east-west dimension) would be captured by the well(s) as shown by the particle tracking on Figure 2.3 for the 225 to 270-foot bgs aquifer interval. The well locations are within the area of the highest VCM concentrations and are appropriate for VCM control. The particle tracks on Figures 2.4 show that the majority of the VCM with concentrations greater than 100 micrograms per liter (µg/L) in this aquifer interval will be captured by the MW-52 area wells. These locations also would reduce the quantity of chemicals from the Northrop/Navy sites (e.g., TCE = 12000 µg/L at well HN-24I) that would require treatment at the MW-52 area system treatment facility. The depth and locations of the two 50 gpm wells (i.e., VCM-2 and VCM-3) were selected to extract VCM which is downgradient of the zone of capture of the upgradient well to provide assurance that GP-1 will not require supplemental VCM treatment in the future because of the VCM from the MW-52 area. Two wells pumping at a low rate were selected rather than increasing the pumping rate of the upgradient well. Increasing the pumping rate of the upgradient well would expand the east-west width of the capture zone which could draw groundwater with elevated TCE/PCE concentrations from the Northrop/Navy sites (e.g., from the area of HN-24I). This is not desirable as it would spread the TCE/PCE further west and increase the cost of treatment for the MW-52 area system.

The area of VCM presence shown on Figure 2.1 was determined based on analytical results from groundwater samples collected in April and May 1996. It is likely that the VCM has migrated further to the south since that time. Thus, two new well nests (i.e., MW-58 and MW-59) will be installed at the locations shown on Figure 2.1 to confirm the southerly extent of VCM presence. This information will be used to ensure that the MW-52 area wells are properly located. The boreholes will be installed using the hydropunch technique so that the appropriate intervals to be screened by the individual monitoring wells in each well nest can be determined.

It is proposed to locate the treatment facility for the MW-52 area system in the southwest corner of the Ruco property and discharge the treated water to an on-site recharge basin to be constructed in the northwest portion of the Ruco property (see Figure 2.1).

OxyChem has performed a number of simulations which used the IRM pumping rates and wells proposed by Northrop at the time the simulations were performed (e.g., pumping of wells GP-11, GP-13, and GP-16 were part of the original Northrop IRM but was deleted for the IRM presented in the Draft Final Regional Groundwater Feasibility Study (RGFS) dated March 1998). The deletion of pumping wells GP-11, GP-13, and GP-16 is expected to slightly increase the future VCM concentrations migrating to well GP-1. It is expected that the increase in concentration will be small because the maximum concentrations reached in these three wells was low, as described below. Thus the mass of VCM removed by wells GP-11, GP-13, and GP-16 would have been small.

The following pumping rates were used for the Northrop IRM wells.

Northrop IRM Wells	*Simulated Pumping Rates (gpm)*
• Wells	
GP-1	1,100
GP-11	540
GP-13	610
GP-16	770
ONCT-1D	1,000
ONCT-2D	700
ONCT-3D	600
• Pumping Period	0 to 85 years

The simulations assumed that the groundwater extracted by the MW-52 area wells would be discharged to the Northrop Plant 12 sumps following treatment. It is now proposed to either discharge the treated water to a recharge basin to be constructed in the northwest portion of the Ruco Site and/or to use the treated water to flush the deeper soils underlying Sump 1, Sump 2, and the area of monitoring well E at the Ruco Site (soil flushing is a component of the OU-1 remedy). These locations are upgradient of the area with elevated VCM presence. Thus, it is expected that such recharge would flush the VCM to well VCM-1, resulting in a quicker decrease in concentrations than those shown on Figure 2.4.

The distribution of VCM concentrations in each layer of the computer model resulting at the end of the 7.5 year pumping periods was then used as the initial condition for subsequent VCM migration simulations with pumping of the Northrop IRM wells only. The simulations were conducted for a total 85-year time period.

The simulations were performed using the modified computer model described in the report entitled "Prediction of Chlorinated Solvent Migration in the Bethpage Regional Aquifer" dated November 1996. The chemical migration simulations included the effect of adsorption, which is small because of the low organic content of the aquifer, and did not include the effect of in-situ remediation.

The simulated VCM concentrations over the 85 year time period at the Northrop IRM wells GP-1, GP-11 and GP-13 and at the three MW-52 area wells (VCM-1, VCM-2, and VCM-3) are shown on Figure 2.4 and summarized in Table 2.2. VCM concentrations at GP-16 were too low to plot. The VCM concentrations at VCM-1 decrease rapidly from approximately 2150 μg/L at the start of pumping to 40 μg/L over the 7.5 year pumping period. The VCM concentrations at VCM-2 are 1 μg/L at the start of pumping, increasing to 16 μg/L after approximately 3 years and then decreasing to 10 μg/L at the end of the 7.5 year pumping period. The VCM concentrations at VCM-3 are 24 μg/L at the start of pumping, decreasing to 20 μg/L after less than 1 year, increasing to 31 μg/L at approximately 4 years and then decreasing to 24 μg/L at the end of the 7.5 year pumping period.

2.3 DISCUSSION

The above simulation results show that the maximum VCM concentration in well GP-1 will be on the order of 1 μg/L if a multiple well system pumping at a total rate of 600 gpm for a time period of 7 to 8 years is installed in the MW-52 area. The 1 μg/L concentration is below the MCL of 2 μg/L for VCM and is also below the groundwater concentration of 8.3 μg/L which would require supplemental VCM treatment at GP-1. Thus, well GP-1 will be protected. All the VCM that is not removed by the MW-52 area wells will be captured by the Northrop IRM wells. Thus, the closest downgradient Bethpage water supply wells (i.e., B6-1 and B6-2 which are located approximately 5,600 feet downgradient of well GP-1) will also be protected.

Another factor which will provide additional protection for the Bethpage water supply wells is natural attenuation (i.e., dilution/dispersion) which will further decrease the VCM concentrations for any VCM containing groundwater migrating beyond the Northrop IRM wells should the Northrop IRM shut down. It is likely that any VCM containing groundwater migrating past the IRM wells would be drawn back to the IRM wells when they resume pumping after a shut-down.

The Draft Final RGFS revised the planned Northrop IRM by deleting the pumping of wells GP-11, GP-13, and GP-16. This change in pumping rates will slightly increase the future VCM concentrations migrating to well GP-1. It is expected that the increase in concentration will be small because the maximum concentrations reached in these three wells was low, thus the mass of VCM removed by wells GP-11, GP-13, and GP-16 would have been small. For example, the maximum VCM concentration reached in any of the above three wells was approximately 7 μg/L in well GP-11 compared to the concentrations at the MW-52 area wells which were much higher (see Figure 2.4). Thus, it is believed that for the current planned Northrop IRM pumping rates the future VCM concentrations at well GP-1 will still be on the order of 1± μg/L if a multiple well MW-52 area system pumping at a total pumping rate of 600± gpm for a period of 7 to 8 years is implemented.

2.4 POTENTIAL IMPACT TO BETHPAGE WELLS

The simulations described in the preceding sections show that all the VCM from the MW-52 area will be captured by the Northrop IRM wells. Supplemental pumping of MW-52 area wells will reduce the VCM concentrations migrating to GP-1 so that supplemental treatment will not be needed. Simulations were performed assuming no pumping of the Northrop IRM wells GP-1, GP-11, GP-13, GP-16, ONCT-1D, ONCT-2D, and ONCT-3D to provide an indication of the potential maximum VCM concentrations which may reach the Bethpage water supply wells located downgradient of Northrop, Navy and Ruco sites.

Figures 2.5, 2.6, and 2.7 show the VCM concentration in modified model layers 5, 8, and 11 after 85 years of migration. The contours show that the VCM remaining after the 7.5 year pumping period of the MW-52 area wells has migrated to the vicinity of well GP-1 at concentrations on the order of 70 µg/L. This higher concentration is the result of the southerly migration of VCM from the vicinity of GP-8 to GP-1. The VCM in the vicinity of GP-8 was partially removed by the pumping of wells GP-11 and GP-13 in the previous alternatives.

The plotted results shown that after 85 years of migration, the VCM has only migrated approximately 500 feet south of the ONCT-series wells at a concentration of 1 µg/L which is below the MCL of 2 µg/L. VCM has not migrated to the closest downgradient Bethpage water supply wells (i.e., B6-1 and B6-2) which are located approximately 4,000 feet south of the 1 µg/L contour.

Figures 2.5, 2.6, and 2.7 show that the Bethpage water supply wells will not be impacted by the VCM from the area of MW-52 after 85 years of migration even without the Northrop IRM wells pumping. The RGFS has shown that the Northrop IRM may need to pump for an 85-year time period or longer to remediate the TCE/PCE upgradient of the IRM wells. Pumping of the IRM wells will capture any VCM which is not removed by the MW-52 area wells. Thus, the Bethpage water supply wells are protected.

3.0 MW-52 AREA SYSTEM ESTIMATED COSTS

3.1 GROUNDWATER CONCENTRATIONS FOR ESTIMATING TREATMENT COSTS

The groundwater extracted by the MW-52 area wells will be a combination of water from four aquifer intervals and will contain trichloroethene (TCE), perchloroethene (PCE) and VCM. It was necessary to estimate the concentrations of these compounds in the groundwater extracted by the MW-52 area wells to estimate the costs for groundwater treatment. Based on prior evaluations, the treatment system will consist of an air stripper with catalytic oxidation of the off-gas.

The majority of the water will be drawn from the aquifer intervals screened by well VCM-1 (i.e., 180 to 270 ft. bgs) because of its higher flow rate. Lesser amounts will be drawn from the aquifer intervals (i.e., 270 to 366 ft. bgs) screened by VCM-2 and VCM-3 because of their lower flow rates.

The concentrations of TCE and PCE in the extracted groundwater were estimated using the following weighting scenario:

Interval	*Percentage of Flow Contributed by Interval*
35 to 100 ft bgs	10
100 to 180 ft bgs	40
180 to 270 ft bgs	40
270 to 500 ft bgs	10

The TCE, PCE, and VCM concentrations will change with time during pumping. The concentration of VCM in the extracted groundwater was calculated by the chemical migration model and is shown on Figures 2.4. The TCE and PCE concentrations are expected to increase initially as groundwater from the area of MW-52 is drawn to the extraction wells. The TCE and PCE concentrations in the wells closest to the proposed MW-52 area wells and the above flow contributions were used to obtain the estimated concentrations in the extracted groundwater.

Extracted groundwater VCM concentrations will be a mixture from the MW-52 area wells. Flow weighted year 0 and year 7.5 VCM concentrations are 1800 µg/L and 36 µg/L. Figures 2.4 shows that simulated VCM concentrations in the groundwater extracted by well VCM-1 decreases rapidly to less than 1800 µg/L (i.e., after approximately 6 months) and are below 450 µg/L after approximately 2 years. Thus, for the majority of the time when the MW-52 area wells are pumped, the simulated VCM concentrations in the extracted groundwater are below 1800 µg/L (7± years) and are below 450 µg/L for 5.5 years. Therefore, costs estimated using 450 or 1800 µg/L as the VCM concentration for the entire 7.5 year pumping period will provide conservative (i.e., high) cost estimates.

Two concentration scenarios, low and high concentration, were evaluated to provide an indication of the sensitivity of estimated costs to changes in chemical concentrations.

	Estimated Concentration (µg/L)	
Compound	***Low***	***High***
TCE	100	250
PCE	40	70
VCM	450	1800

3.2 ESTIMATED COSTS

3.2.1 CAPITAL COSTS

Details of the estimated capital cost are shown in Table 3.1. The estimated capital cost is $3,128,000.

3.2.2 OPERATION AND MAINTENANCE COSTS

VCM sentry monitoring is proposed to be performed at eight existing wells (MW-52 S, I and D, MW-53I, D1 and D2, GM-12I, and GM-23I (see Figure 3.1) and the two new well nests (MW-58 and MW-59). Well nest MW-52 is the well with the highest VCM concentrations and was selected to observe the trend in VCM concentrations. Well nest MW-53, at which VCM has not been detected, was selected to monitor the groundwater west of the VCM presence. Wells GM-12I, GM-23I, MW-58 and MW-59 were selected to observe if VCM is migrating southward beyond the VCM source control wells at concentrations which may require supplemental VCM treatment. Wells GP-8 and GP-14 were initially proposed to observe if VCM is migrating to Northrop IRM wells GP-11 and GP-13 at concentrations which may require supplemental VCM treatment. Wells GP-8 and GP-14 can be deleted because wells GP-11, GP-13, and GP-16 are not being pumped as part of the Northrop IRM presented in the Draft Final RGFS.

VCM monitoring and reporting for the MW-52 area pumping wells will be performed monthly.

Information obtained from equipment suppliers showed that the capital costs of the treatment system did not change significantly for the concentration ranges (i.e., high and low) presented in Section 3.1. Treatment costs were slightly sensitive to the range of concentration as shown in Table 3.1 (i.e., $260,000 annually for the low concentrations compared to $300,000 annually for the high concentrations).

The estimated annual O&M costs are $643,000 for the low concentrations and $691,000 for the high concentrations.

3.2.3 PRESENT WORTH COSTS

The present worth costs for a 7.5-year operating period are $7,066,000 for the low concentrations and $7,360,000 for the high concentrations.

4.0 EVALUATION OF MW-52 AREA SYSTEM

The MW-52 area system described above has been shown capable of achieving the objectives described in Section 2.1. The system is further evaluated in the following paragraphs using the criteria:

i) Effectiveness
- protection of human health and the environment
- reduction in toxicity, mobility, and mass
- permanence of system
- technical reliability

ii) Implementability
- technical feasibility
- administrative feasibility
- availability of suppliers, equipment, etc.
- long-term operation and maintenance

iii) Cost
- capital
- operation and maintenance

4.1 EFFECTIVENESS

The proposed MW-52 area system will remove sufficient VCM mass so that supplemental treatment at GP-1 will not be required. The simulated maximum concentration at GP-1 was on the order of 1 μg/L which is below the MCL of 2 μg/L for VCM. Thus, GP-1 is protected. Groundwater monitoring, as described in Section 3.2.2 will be performed to monitor the effectiveness of the MW-52 area system in achieving the system objectives. The areas to be impacted by construction of the system are within an industrial area which has no sensitive flora or fauna to be adversely impacted. Furthermore, there are no current groundwater users between the MW-52 area and the Northrop IRM wells. Thus, human health and the environment are protected.

The mobility of VCM is reduced by limiting its further southerly migration during the pumping period. The concentrations that remain after pumping stops will be reduced by natural attenuation. Groundwater with these reduced concentrations will be captured and treated by the Northrop IRM. Thus, the Bethpage water supply wells are protected. Additional protection to the Bethpage water supply wells is provided by the process of natural attenuation downgradient of the Northrop IRM and by the existing treatment systems at the water supply wells. The toxicity and mass are reduced by extracting and treating the groundwater. Treatment of the air stream by catalytic oxidation protects the on-site works and community.

The risks during construction of the system will be minimized using appropriate health and safety measures. Risks to operators of the treatment system will be controlled through the use of appropriate operation and maintenance procedures.

Regarding the permanence of the system, it is planned that the MW-52 area system will only be operated for a limited period of time until the VCM groundwater concentrations in VCM-1 reduce to approximately 40 μg/L. It is simulated that this will require 7 to 8 years of pumping.

The technologies that would be used for the MW-52 area system (e.g., extraction well pumping and air stripper/catalytic oxidation) are demonstrated and proven technologies for the conditions and chemicals to be addressed.

4.2 IMPLEMENTABILITY

Groundwater extraction by pumping wells is already implemented in the area. The technology uses equipment readily available from several suppliers. A sufficient number of suppliers for the groundwater treatment system are available so that no difficulties in obtaining equipment are foreseen.

Operation requirements will include groundwater monitoring and treatment system operation (e.g., electrical, chemical, and operators). Maintenance may require repair/replacement of system components.

Administrative requirements will include obtaining property and/or property access for installation of the two proposed monitoring well nests and the three pumping wells and for the construction of the forcemain from the wells to the treatment system. This includes obtaining access to bore and jack under the railway line. Local and state permits will also be required for the wells, forcemain, treatment facility, and recharge basin. The treatment facility would require permits for discharge of the treated groundwater and treated air. These permits should be obtainable.

4.3 COSTS

The estimated capital cost is $3,128,000. Annual O&M costs range from $643,000 (low concentrations) to $691,000 (high concentrations).

The estimated present worth cost, based on a 7.5 year operating period, ranges from $7,066,000 to $7,360,000. This range is approximately $1,386,000 to $1,680,000 more than the cost of implementing a 700 gpm system at well GP-2 and $5,780,000 to $6,074,000 less than implementing a 700 gpm system at well GP-5.

4.4 CONCLUSION

The MW-52 area system will achieve the remedial action objectives. It will control the further southerly migration of elevated VCM concentrations from the MW-52 area more efficiently than pumping either GP-2 or GP-5. It is more cost effective than pumping GP-5 and less cost effective than pumping GP-2.

5.0 RUCO SITE SHALLOW GROUNDWATER (OU-1)

The major components of the remedy described in the Record of Decision (ROD) for the Site dated February 16, 1994 for Operable Unit 1 (OU-1) include:

i) Installation of groundwater extraction wells to control the flow of adversely impacted groundwater from leaving the Site and migrating downgradient. Monitoring the performance of the groundwater extraction system and establishing that sufficient control occurs using existing monitoring wells on the Site and, if required, additional monitoring wells.

ii) Installation of an on-Site groundwater treatment system and treatment of the extracted groundwater to achieve the appropriate discharge standards. Treatability studies to determine the exact combination and type of treatment technologies (i.e., granulated activated carbon, ultraviolet oxidation, flocculation, etc.), and their effectiveness on the RSCs.

iii) Installation of a discharge system to recharge the majority of the treated groundwater. The discharge may be to existing sumps or to a sump to be constructed.

iv) Additional soil testing (the bottom of Sump 2 to the water table) to determine if chemical compounds are present in the soils above levels that are considered protective of the groundwater. Soil flushing the soils in Sump 2 using treated water if chemical compounds are present above levels considered protective of the groundwater.

v) Soil flushing the deep soils in Sump 1, and possibly Sump 2 (based on the results of the soil testing) using treated water. Delineate the areas to be flushed and determine the method of treated water discharge during the design phase of the remedial action (RA). Recapture the chemical compounds flushed out by this process using the groundwater extraction wells. Perform treatability studies (e.g., soil column tests) on the soils to evaluate the effectiveness of soil flushing on RSCs. Closure of the existing concrete storage tanks in Sump 1.

vi) Additional soil testing in the area around monitoring well E (MW-E) to determine if chemical compounds are present above concentrations considered to be protective of groundwater quality. Excavate the shallow soils in the area around MW-E if such concentrations are present. Evaluate potential remedial alternatives if such concentrations are present in the deeper soils.

vii) Excavation and off-Site disposal of the soils in the former drum storage area. The extent of the excavation in the former drum storage area to be based on the results of the soil samples collected during the Remedial Investigation (RI) and further sampling to be conducted during the predesign or design phase.

viii) Periodic monitoring of the groundwater extraction system to assure adequate control is maintained; periodic sampling of the groundwater treatment system discharge, to assure treatment standards are achieved; and periodic sampling of the groundwater and soils in Sump 1 and possibly Sump 2 to measure the progress of the selected remedy in achieving the cleanup standards.

ix) Institutional controls in the form of deed restrictions to restrict the Site to industrial/commercial development only, as long as chemical compounds remain on the Site above levels considered appropriate for residential development and the treatment systems are in place. Groundwater use restrictions in addition to the existing Nassau County Ordinance, until such time as the groundwater beneath the Site has been determined to be fully remediated.

Pumping in the MW-52 area has the added benefit of capturing and treating the chemical presence (e.g., RSCs) in the shallow groundwater underlying the Ruco Site thereby providing a remedy for the shallow groundwater component of OU-1. Another component of the OU-1 remedy that can be addressed by the MW-52 area system is the flushing of the chemicals from the deeper soils in the area of Sump 1, Sump 2, and monitoring well nest E using treated water (see Figure 5.1 for soil flushing areas).

The report entitled "Pre-Design Work Plan for Operable Unit 1" (PDWP) dated September 1996 presented the scope of pre-design activities to be performed. Some of the activities described in the PDWP do not need to be performed if pumping wells are installed in the MW-52 area. The items/activities which can be deleted or need to be added are described in the following paragraphs.

Installation and pumping testing of a shallow groundwater extraction well and evaluation of the results is not needed because the MW-52 area wells will capture the groundwater from the Ruco Site (see Figure 2.3). The groundwater extracted by the MW-52 area wells will be treated using the proposed air stripper/catalytic oxidation system, thus a separate on-site treatment system for the Ruco site shallow groundwater is not needed. It is possible that a treatment process (e.g., liquid phase granular activated carbon (LPGAC) or ultra-violet light/chemical oxidation) will need to be added to the MW-52 area treatment system to treat the RSC's if natural attenuation does not reduce the RSC concentrations to 50 μg/L by the time the groundwater is extracted by VCM-1. The actual treatment process will be determined based on the results of the groundwater treatability study described in the PDWP. It is assumed that a liquid phase granular activated carbon system will be added after the air stripper and that the RSC concentration will be on the order of 400 µg/L for cost estimating purposes. The proposed recharge basin in the northwest area of the Ruco Site for the MW-52 area system will be used to recharge the majority of the treated water.

The use of treated water from the MW-52 area treatment system would require the installation of a short length of forcemain from the southwest corner to the southeast of the Ruco plant and the installation of spraying units.

The reduction in estimated costs for the above items/activities are shown below.

Activity	*Capital Cost Reduction*	*Annual O&M Cost Reduction*
Install Extraction Well/Pump	$ 45,000	
Perform Pumping Tests and Evaluate	$ 220,000	
Analyze Pumping Test Samples	$ 10,500	
On-Site Treatment System		
• Construction	$ 300,000	
• Operation		$ 150,000
• Monitoring		$ 19,000
MW-52 Area System		
• LPGAC Construction	$ -100,000	
• LPGAC Operation		$ -30,000
Forcemain/Spray Units		
• Construction	$ -29,000	
• Operation		$ -82,000
Total	**$ 446,500**	**$ 57,000**

The wells shown on Figure 5.1 were last sampled and analyzed in 1994 with the exception of the MW-50 well nest which was sampled and analyzed in April/May 1996. It is proposed to resample the following wells to determine the current SVOC TIC (i.e., RSC) concentrations; E-1, E-2, K-1, K-2, MW-50J1, MW-50J2, MW-50D1, MW-50D2, and P-1. To allow comparison with historic data, the groundwater samples will be analyzed using CLP methods. Based on the results, the effectiveness of natural attenuation on these compounds and the need for a soil treatability study including the need to add nutrients to the flushing water will be evaluated.

Annual O&M costs were estimated assuming that nutrients would be added to the water used for flushing. The nine wells referenced above would be monitored semi-annually for RSCs during the pumping period of the MW-52 area wells. The monitoring program after pumping stops at the MW-52 area wells would be determined based on results obtained during the pumping period. Analysis would be performed using the ketone/glycol/diol (KGD) method developed by OxyChem specifically for the RSCs. The estimated annual O&M costs for these supplements are $82,000.

In summary, the use of the MW-52 area system to address the shallow groundwater component of OU-1 has reduced the estimated OU-1 capital costs by $446,500 and annual O&M costs by $57,000.

6.0 CONCLUSIONS

In summary, the computer simulations, evaluations, and cost estimates show the following:

i) A multiple well system with a total pumping rate on the order of 600 gpm for a pumping period of 7 to 8 years will be needed to ensure that the mass of VCM removed will be protective on the Northrop IRM wells so that future supplemental treatment of VCM will not be needed.

ii) Such a system will ensure that VCM will not reach the Bethpage water supply wells at concentrations which would exceed the MCL of 2 μg/L even if the Northrop IRM wells are not pumping.

iii) Such a system has the added benefit of addressing shallow groundwater and soil flushing components of OU-1.

iv) The MW-52 area system will achieve these objectives.

7.0 RECOMMENDED SYSTEM

Based on the computer simulations and evaluations described in the preceding sections, it is recommended that the MW-52 area system be implemented, subject to revision depending on the results obtained from installing and sampling monitoring well nests MW-58 and MW-59.

In summary, the MW-52 area system consists of:

i) VCM-1 to be installed approximately 500 feet downgradient of MW-52 pumping at 500 gpm.

ii) VCM-2 and VCM-3 to be pumped at 50 gpm each.

iii) Pumping will continue until the VCM concentration in VCM-1 reduces to 40 µg/L. It is estimated pumping for 7 to 8 years will be needed to achieve this concentration.

iv) The pumped groundwater will be treated at a treatment facility to be constructed in the southwest portion of the Hooker/Ruco facility.

v) Treated water will be:

   a) used to flush the soils in the area of Sump 1, Sump 2, and/or monitoring well E; and

   b) discharged to a recharge basin to be constructed in the northwest portion of the Hooker/Ruco facility.

vi) Monitoring will be performed at 12 wells semi-annually to monitor the effectiveness of the system.

A schematic plan of the MW-52 area system is shown on Figure 2.1. The estimated capital cost for the OU-3 component of the system is $3,128,000 with an annual O&M cost ranging from $643,000 for the low concentration scenário to $691,000 for the high concentration scenario. The MW-52 area system has the added benefit of addressing the shallow groundwater component of OU-1. Such use has been estimated to reduce the OU-1 capital costs by $446,500 and reduce the annual O&M costs by $57,000.

FIGURES

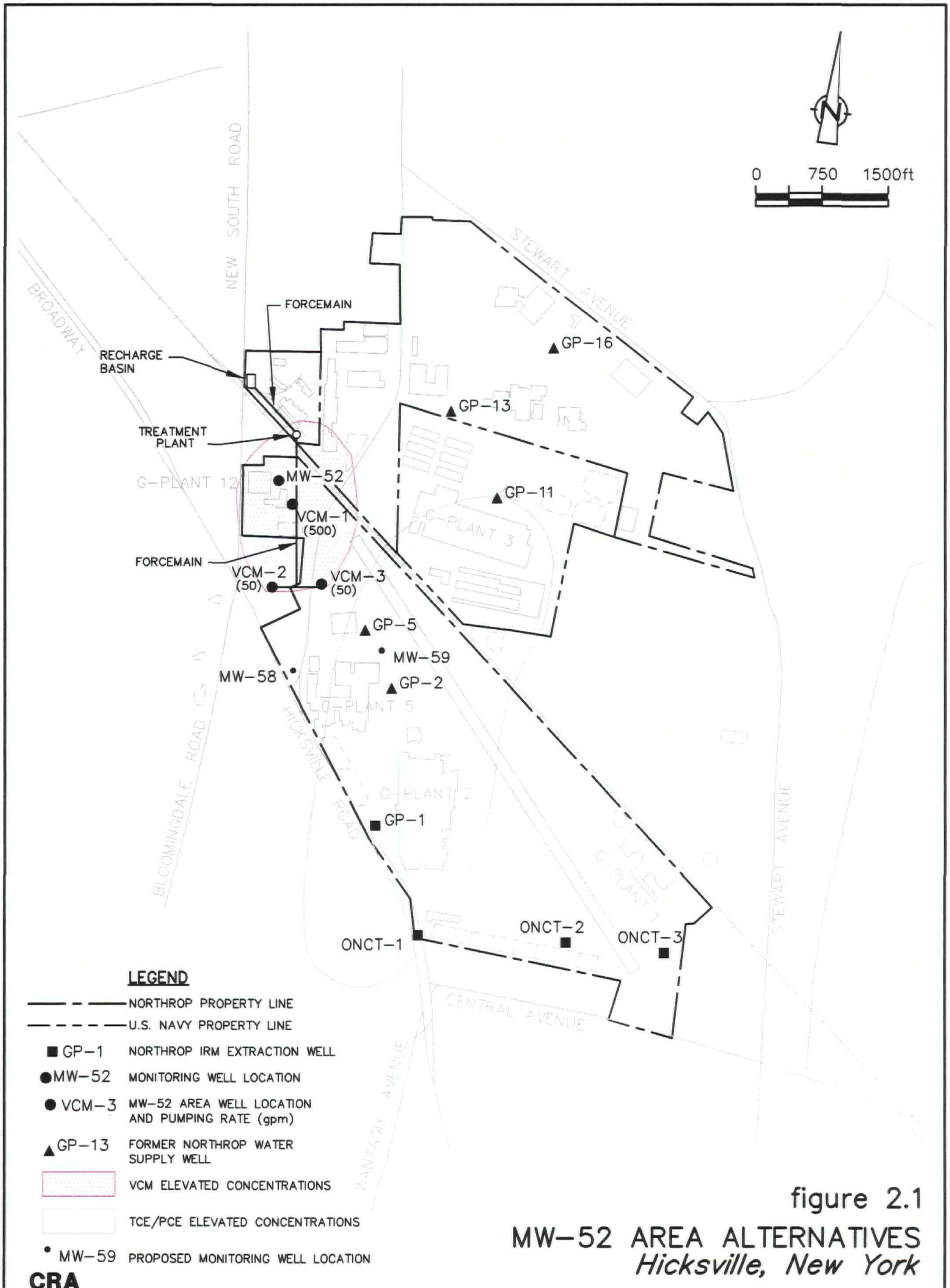

figure 2.1

MW-52 AREA ALTERNATIVES
Hicksville, New York

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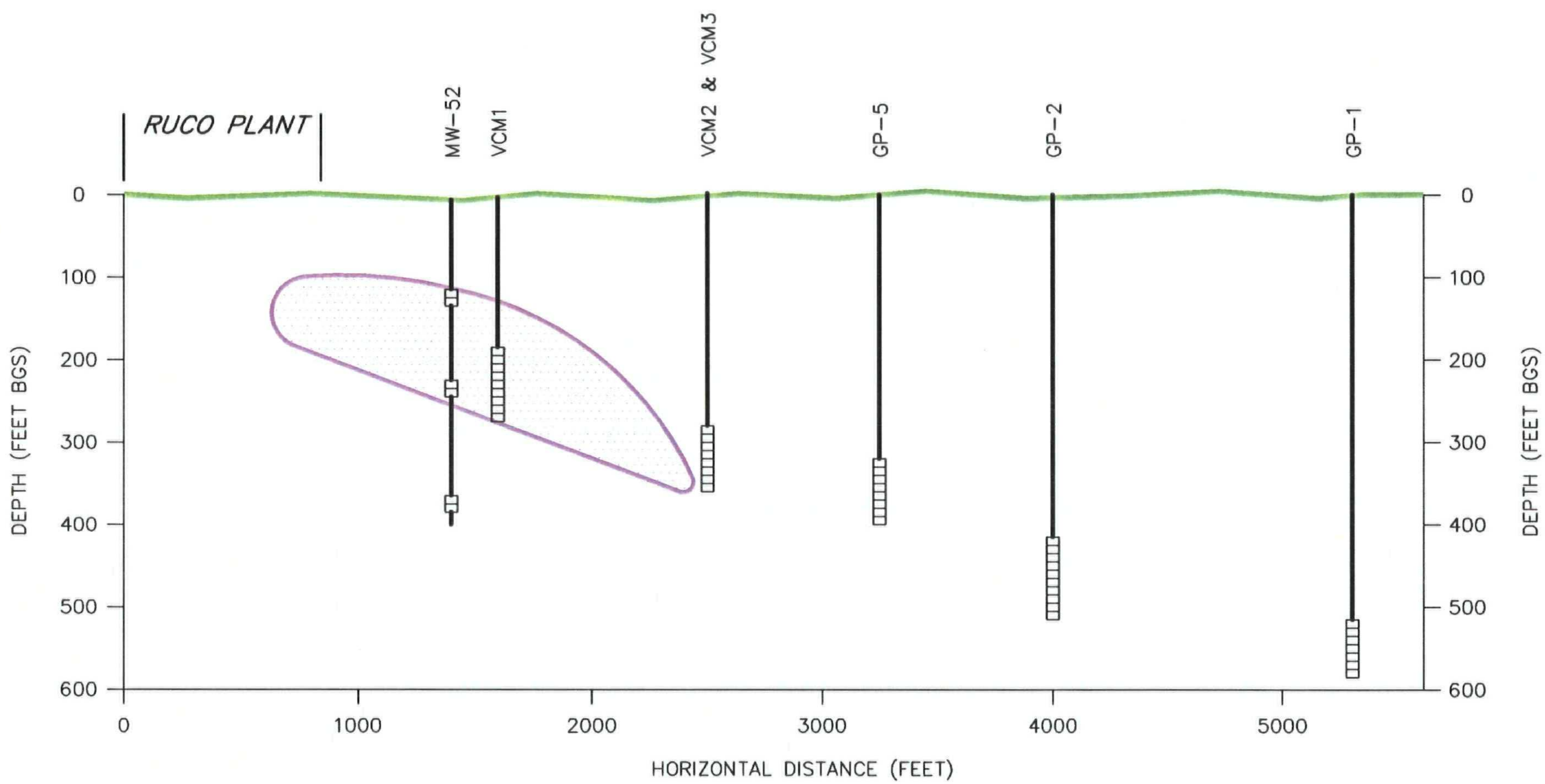

figure 2.2

SCHEMATIC CROSS-SECTION
MW-52 AREA ALTERNATIVES
Hicksville, New York

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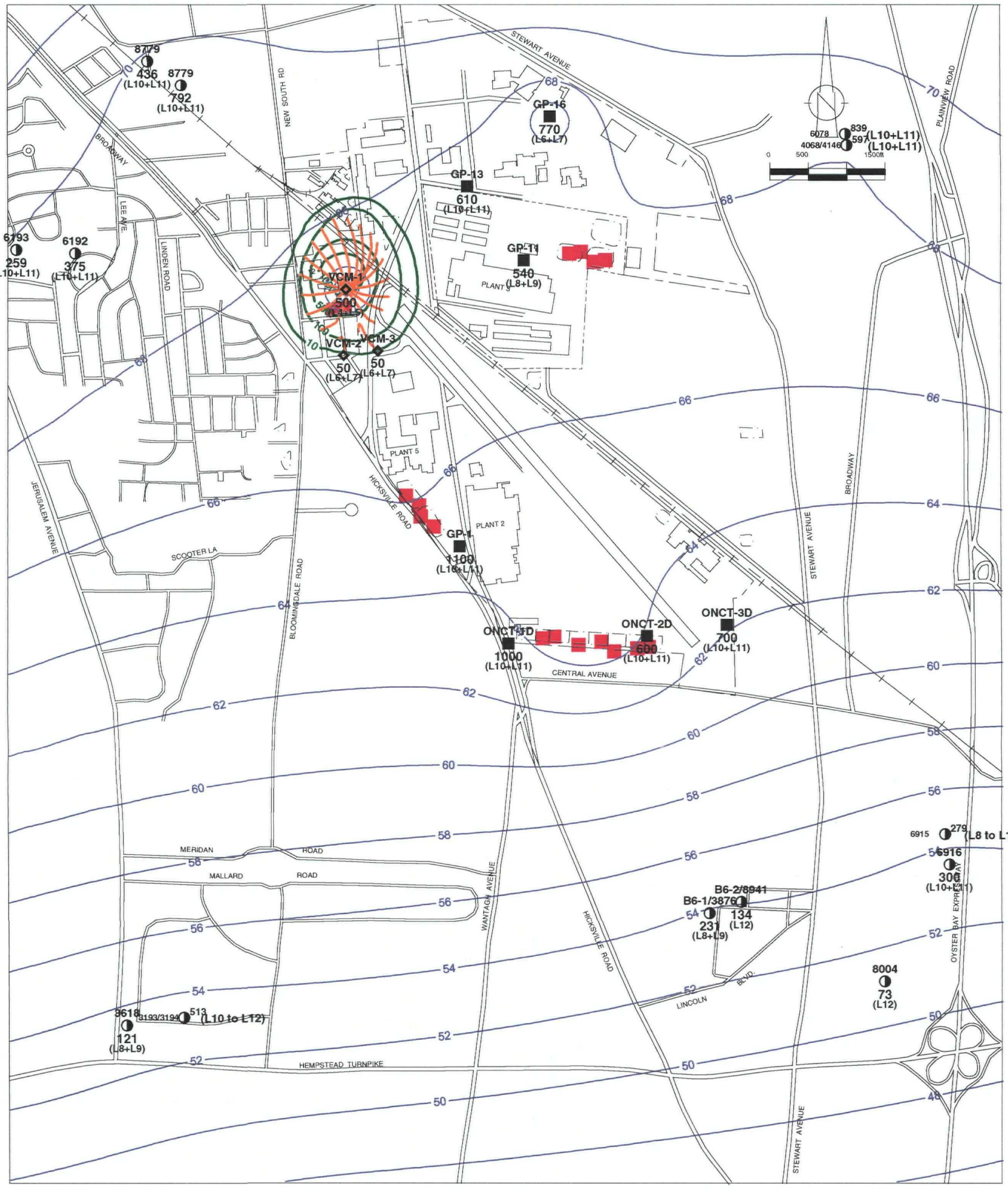

Legend

Active sump/recharge basin location.

GP-1 1100 (L10+L11) Northrop IRM pumping well location and pumping rate (gpm).

6192 375 (L10+L11) Municipal pumping well location and pumping rate (gpm).

VCM-1 500 (L4+L5) VCM extraction well location and pumping rate (gpm).

—10— Observed VCM concentrations in the Deep Zone (225 to 270 FBGS) (ug/L).

—68— Simulated steady-state hydraulic head in layer 5 (ft amsl).

Simulated particle pathways in layer 5.

figure 2.3

NORTHROP IRM (ORIGINAL PUMPING) WITH VCM-1 AT 500 GPM, VCM-2 AND VCM-3 AT 50 GPM SIMULATED STEADY-STATE HYDRAULIC DISTRIBUTION IN LAYER 5 OF REVISED TRANSPORT MODEL (DEEP ZONE 225 TO 270 FBGS)

Hicksville, New York

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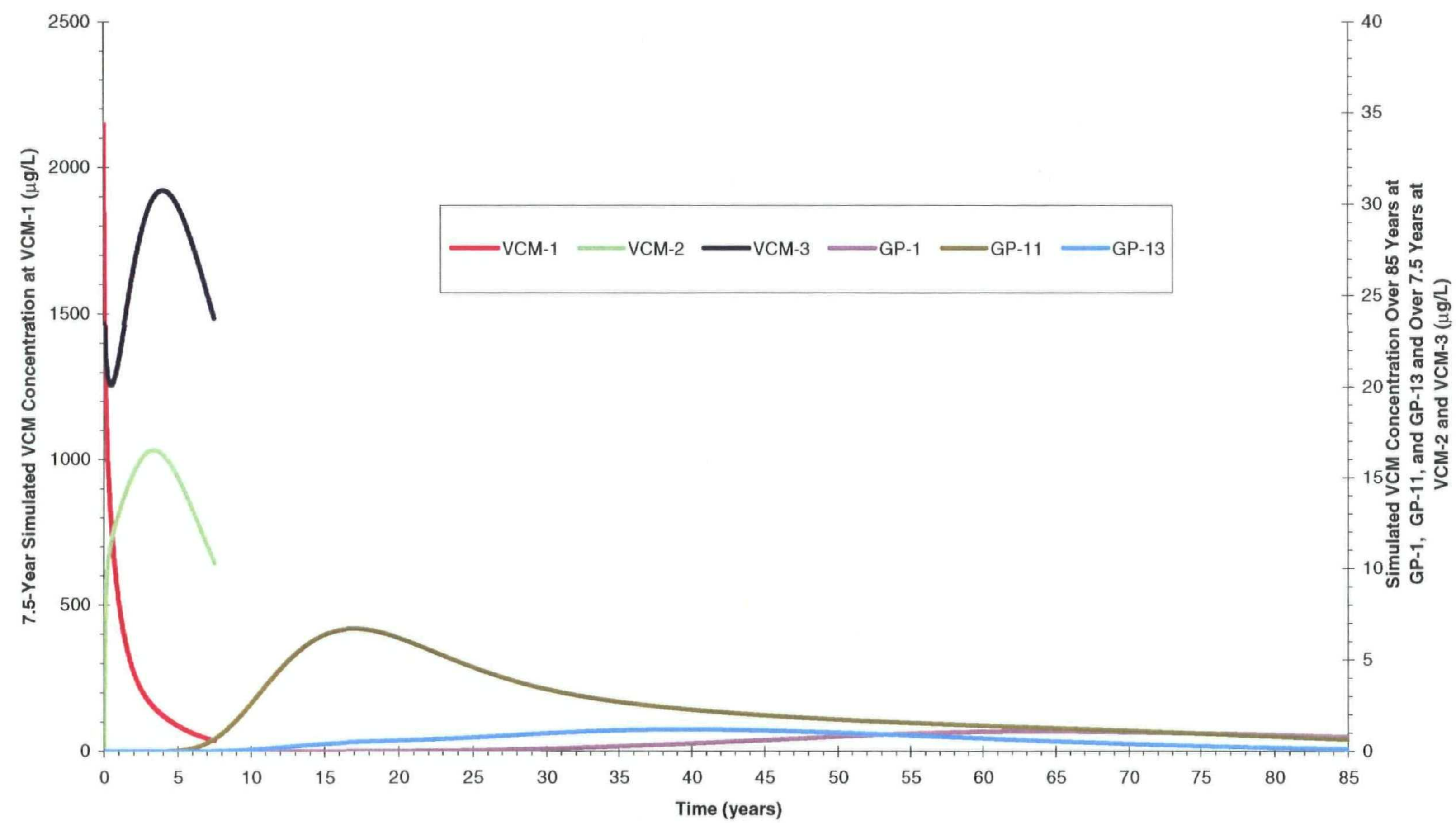

figure 2.4

NORTHROP IRM (ORIGINAL PUMPING) WITH VCM-1 AT 500 GPM, VCM-2 AND VCM-3 AT 50 GPM FOR 7.5 YEARS
VCM CONCENTRATION PROFILE OVER 85 YEARS AT GP-1, GP-11, AND GP-13, AND OVER 7.5 YEARS AT VCM-1, VCM-2, AND VCM-3

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Hicksville, New York

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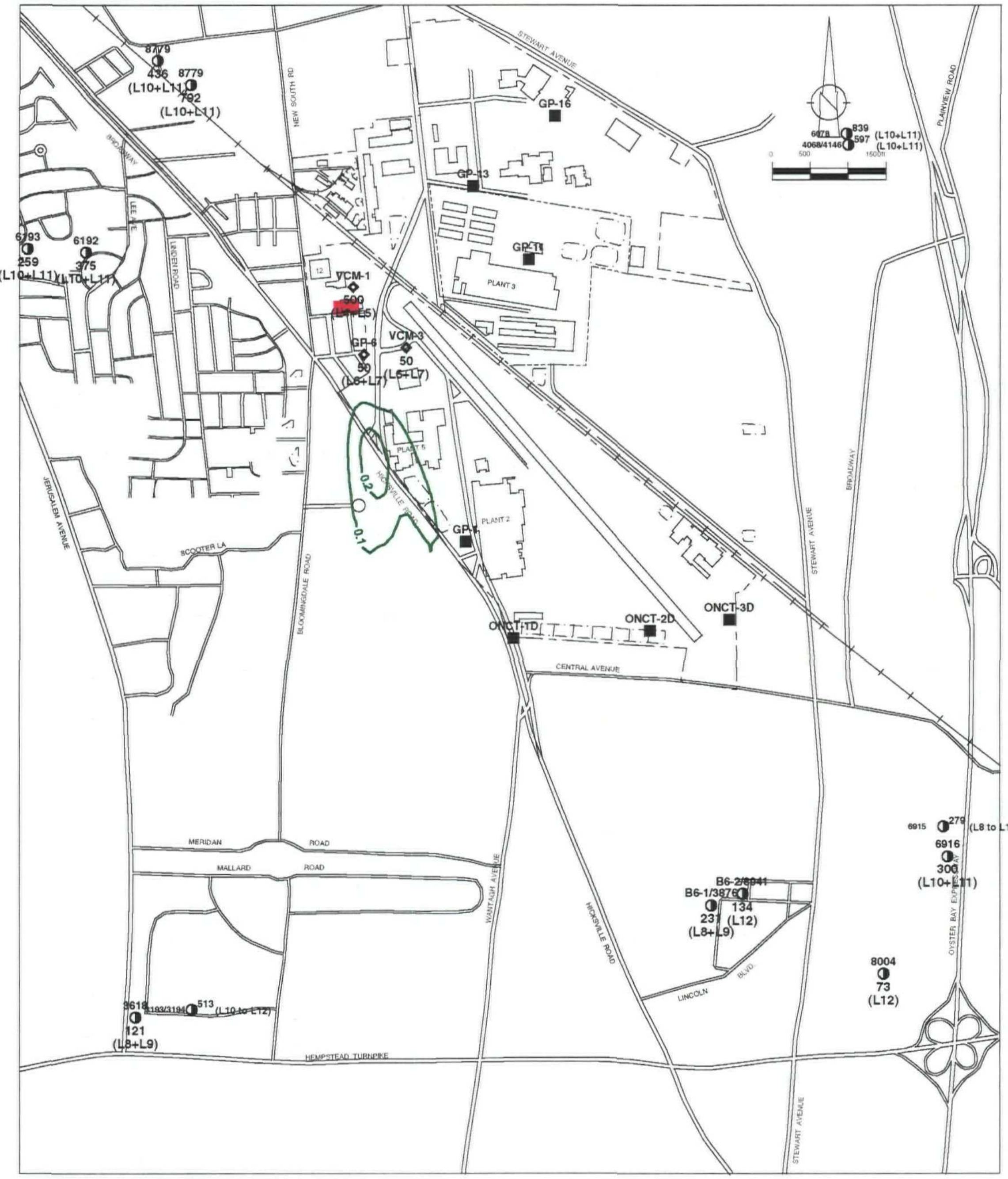

Legend

Active sump/recharge basin location [for first 7.5 years only].

GP-1 — Northrop IRM pumping well location [not pumping].

6192 375 (L10+L11) — Municipal pumping well location and pumping rate (gpm).

VCM-1 500 (L4+L5) — VCM extraction well location and pumping rate (gpm) [for first 7.5 years only].

— 10 — Simulated VCM concentrations after 85 years (ug/L).

figure 2.5
NORTHROP IRM NOT PUMPING
85-YEAR SIMULATED VCM CONCENTRATIONS IN LAYER 5
OF REVISED TRANSPORT MODEL (DEEP ZONE FROM 225 TO 270 FBGS)
Hicksville, New York

CRA

Legend

Active sump/recharge basin location [for first years only].

GP-1 — Northrop IRM pumping well location [not pumping].

6192 / 375 / (L10+L11) — Municipal pumping well location and pumping rate (gpm).

VCM-1 / 500 / (L4+L5) — VCM extraction well location and pumping rate (gpm) [for first 7.5 years only].

—10— Simulated VCM concentrations after 85 years (ug/L).

figure 2.6
NORTHROP IRM NOT PUMPING
85-YEAR SIMULATED VCM CONCENTRATIONS IN LAYER 8 OF REVISED TRANSPORT MODEL (D2 ZONE FROM 365 TO 430 FBGS)
Hicksville, New York

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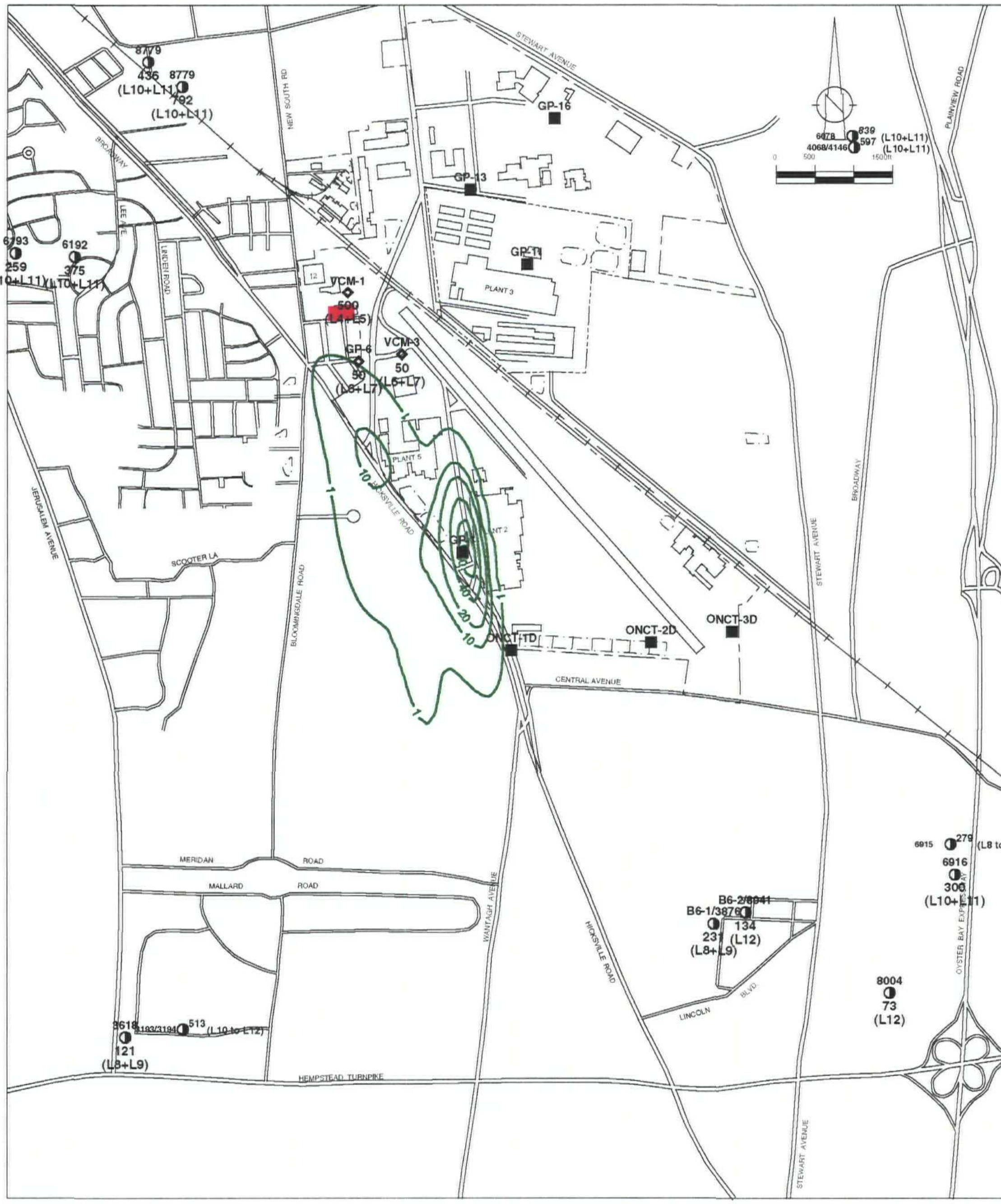

<u>Legend</u>

Active sump/recharge basin location [for first 7.5 years only].

GP-1 — Northrop IRM pumping well location [not pumping].

6192 / 375 / (L10+L11) — Municipal pumping well location and pumping rate (gpm).

VCM-1 / 500 / (L4+L5) — VCM extraction well location and pumping rate (gpm) [for first 7.5 years only].

—10— Simulated VCM concentrations after 85 years (ug/L).

figure 2.7

NORTHROP IRM NOT PUMPING

85-YEAR SIMULATED VCM CONCENTRATIONS IN LAYER 11 OF REVISED TRANSPORT MODEL (BELOW D2 ZONE FROM 552.5 TO 610 FBGS)

Hicksville, New York

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400033

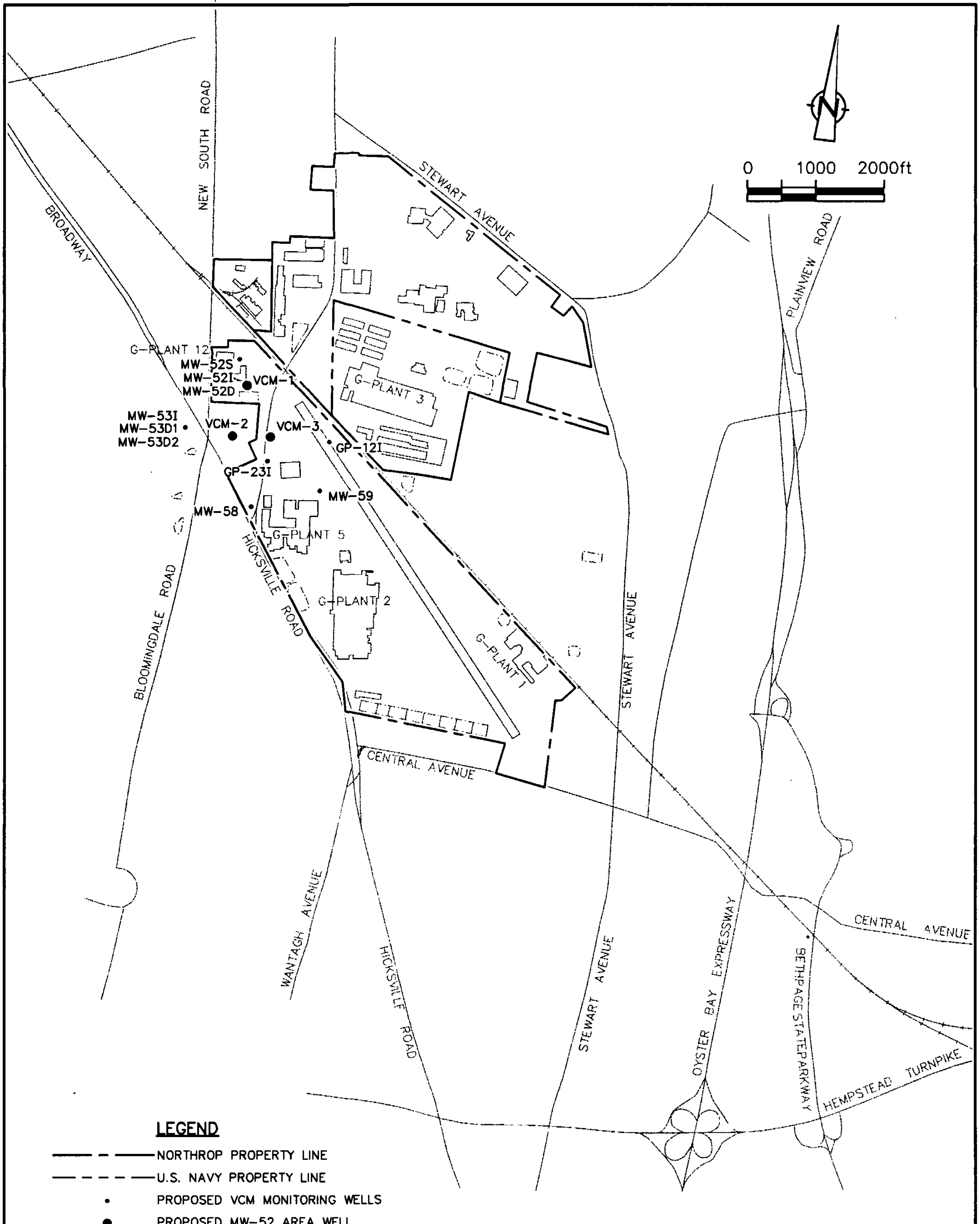

figure 3.1

PROPOSED VCM MONITORING WELLS
Hicksville, New York

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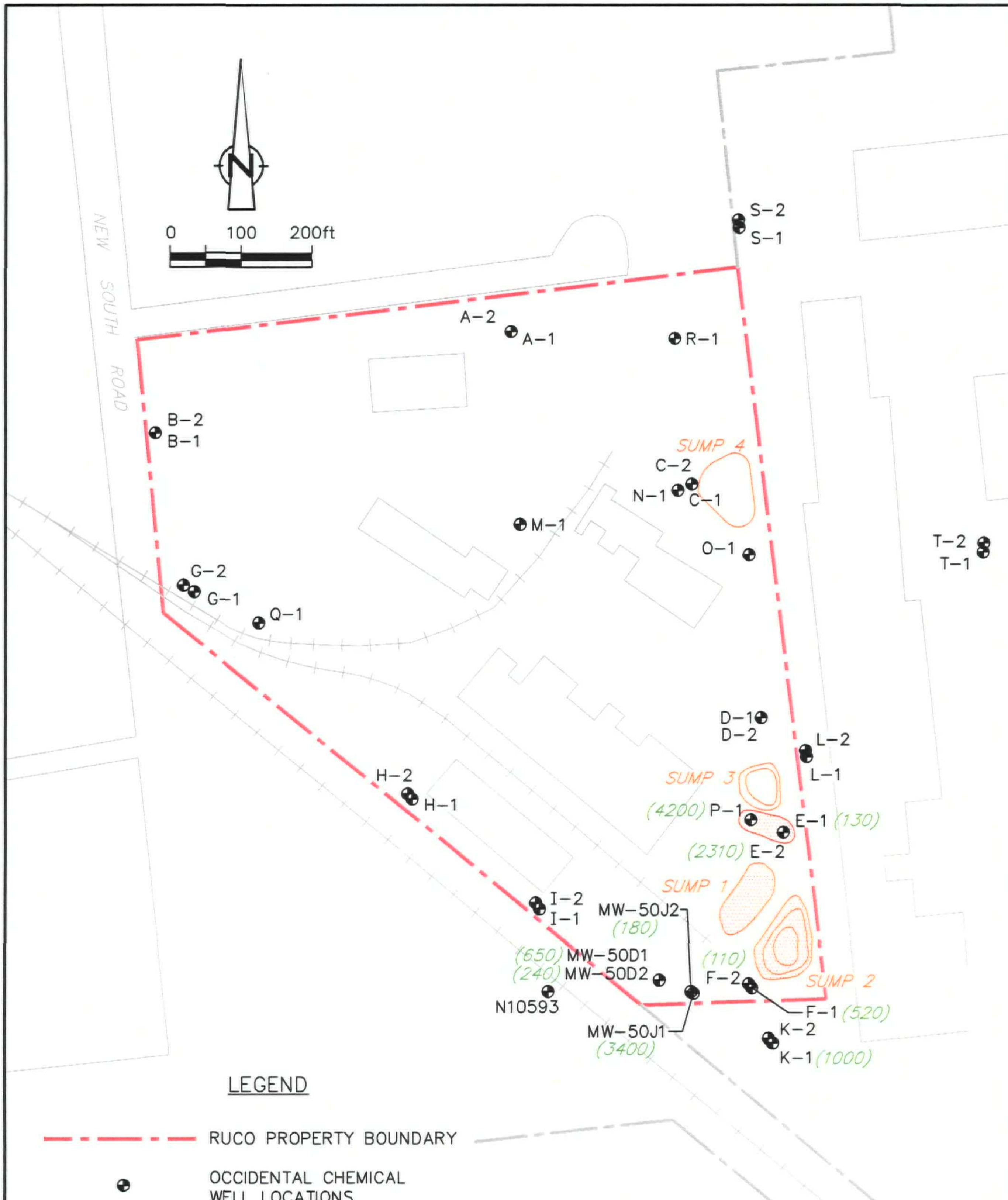

figure 5.1

PROPOSED RSC MONITORING WELLS
Hicksville, New York

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TABLES

TABLE 2.1

MAXIMUM ALLOWABLE NORTHROP IRM AIR STRIPPER VCM LOADINGS AND INFLUENT CONCENTRATIONS
HOOKER/RUCO SITE
HICKSVILLE, NEW YORK

NYSDEC AGC for Vinyl Chloride = 0.02 ug/m^3

Air Guide 1 Equation: $C(ug/m^3) = (52500 * Q/h_e^{2.25}) * GEP$

where: Q=emission rate (lbs/hr)
h_e=effective stack height
GEP=reduction factor for Good Engineering Practice (GEP) stack height=0.4

Stripper	*Actual Stack Height (1) (feet)*	*Estimated Air Flow Rate (cfm)*	*Allowable VCM Emission Rate, Q (2) Air Guide 1 (lbs/hr)*	*Flow Rate (gpm)*	*Maximum Allowable Influent Concentration (3) (µg/L)*
GP-1 Air Stripper	65	5600	0.011	1100	8.3
ONCT Air Stripper	70	9225	0.013	1300	8.0

Notes:

AGC - Annual Guideline Concentration
GEP = 0.4
(1) Actual stack height assumed to be h_e for Air Guide 1 equation (i.e., no momentum or buoyancy included).
(2) Air Guide 1 dispersion modeling (September 1996) considered stripper towers to be point sources.
(3) Not to exceed VCM AGC of 0.02 $\mu g/m^3$.

TABLE 2.2

SUMMARY OF MW-52 AREA SYSTEM
SIMULATIONS
BETHPAGE REGIONAL AQUIFER

Pumping Well VCM-1	*Pumping Rate (gpm)*	*Period of Pumping (Years)*	*Feet Downgradient of MW-52*	*Pumping Interval (ft bgs)*	*Pumping Well VCM Concentration (µg/L)*		*Max. VCM Concentration in GP-1 (µg/L)*	*Concentration of Other Compounds to be Treated (µg/L)*		*Estimated Costs ($1,000s)*		
					Max.	*End of Pumping*		*TCE*	*PCE*	*Capital*	*Annual O&M*	*Present Worth*
VCM-1	500	7.5	500	180 to 270	2150 (1)	40	<1	100 to 250	40 to 70	$3,128	$643 to $691	$7,066 to $7,360
VCM-2	50	7.5	1,000	270 to 365	16 (2)	10						
VCM-3	50	7.5	1,000	270 to 365	31 (3)	24						

Notes:

(1) At start of Pumping.

(2) 3± Years after pumping starts.

(3) 4± Years after pumping starts.

TABLE 3.1

OU-3 REMEDY COST ESTIMATES
MW-52 AREA SYSTEM
BETHPAGE REGIONAL AQUIFER

CAPITAL COSTS

• Well Installation		
- Large Pumping Well	$	150,000
- Two smaller pumping wells	$	200,000
- 2 monitoring well nests	$	160,000
• Well Pumps		
- Large Well	$	25,000
- Two smaller well(s)	$	10,000
• Forcemain		
- Wells to Treatment Building	$	275,000
- Treatment Building to Recharge Basin	$	105,000
• Recharge Basin		
- Investigations and Evaluations	$	5,000
- Construction (soil disposed off-site as clean fill)	$	50,000
• Land Purchase/Access Payments		
- Wells/Forcemain	$	50,000
• VCM Treatment System		
i) Equipment		
- Pumps	$	12,000
- Tanks	$	75,000
- Air Stripper	$	120,000
- Catalytic Oxidizer	$	250,000
- Filters	$	20,000
- Taxes	$	24,000
ii) Materials and Installation		
- Site Improvements	$	20,000
- Concrete Structures	$	120,000
- Equipment Super Structure	$	50,000
- Building Super Structure	$	60,000
- Piping, Millwrighting	$	180,000
- Instrumentation	$	90,000
- Electrical	$	110,000
- Insulation	$	37,000
- Painting	$	25,000
- Rigging	$	44,000
Sub-total	$	2,267,000

TABLE 3.1

OU-3 REMEDY COST ESTIMATES
MW-52 AREA SYSTEM
BETHPAGE REGIONAL AQUIFER

CAPITAL COSTS

Engineering and Procurement		$ 227,000
Field Construction Expense		$ 113,000
Subtotal		$ 2,607,000
Contingency (20%)		$ 521,000
TOTAL CAPITAL		$ 3,128,000

ANNUAL OPERATION AND MAINTENANCE

	Low Conc.	*High Conc.*
• VCM Treatment System	$ 260,000	$ 300,000
• VCM Monitoring		
- Sentinel Wells (12 wells - semi-annually)	$ 28,000	$ 28,000
- Treatment System (monthly)	$ 19,000	$ 19,000
• Reporting (Monthly)	$ 34,000	$ 34,000
• Labor (1 person full time)	$ 65,000	$ 65,000
• Equipment Replacement (5% of Capital Sub-total)	$ 130,000	$ 130,000
Sub-total	$ 536,000	$ 576,000
Contingency (20%)	$ 107,000	$ 115,000
TOTAL ANNUAL O&M	$ 643,000	$ 691,000
PRESENT WORTH (7.5 years, 5% discount factor)	$ 7,066,000	$ 7,360,000